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STUDY OF RABBIT MEAT AND CARCASS
Criteria and terminology

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INTRODUCTION

In the last World Congress on Cuniculture, it was suggested that a proposal to standardize the criteria for carcass measurements and retail cuts be prepared. This suggestion was taken up by the Mediterranean Rabbit Group Conference of the IAMZ-CIHEAM and a Commission on rabbit meat and carcass was created, with the objective of standardizing criteria and terminology, and proposing minimum requirements for the experiments. It has been the task of the Commission :

1/ To specify the main traits to be considered from the birth of the animal to carcass and meat analyses,
2/ To define these traits with enough precision,
3/ To propose a common terminology,
4/ To establish guidelines for the design of experiments,
5/ To prepare a lexicon in four languages.

This list of traits does not intend to be exhaustive, because it is not possible to list and cover all the possible types of experiments. It is not our intention, either, to prepare a fixed amount of obligatory norms that could limit scientific freedom. However, if a scientist prefers to use different traits or routines,it would be convenient to specify both as accurately as specified in this document. Some of the indications are general recommendations, some are interesting only in certain experiments, and some of them are strongly recommended for all experiments.

Some of the traits proposed by this Commission can be a matter of discussion -vgr. "liveweight", "reference weight", "commercial carcass", "technological retail cuts"-. This paper cannot contain an extensive justification of the reasons for choosing and defining each trait. It is clear, however, that this list can be modified in the future, not only after checking how it works but also because new developments can appear in the scientific and commercial world.

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Part of the recommendations for experiment design can be found in standard statistical textbooks and in the guide for authors of the main scientific journals. Nevertheless the Commission has considered it convenient to set up guidelines for research by proposing a minimum number of animals to be used depending on the nature of the trait and on the accuracy that could be considered admissible.

STANDARD MEASUREMENTS

1/ BREEDING CONDITIONS AND LIVING ANIMAL

1.1. Age at weaning

The birth of rabbits, even in a planified experiment, takes place in a period of 2 or 3 days. However, rabbits are usually weaned on a fixed day of the week. It is recommended to specify the number of days between the average day of birth and the day of weaning.

1.2. Type of weaning

It is recommended to explain how the weaning is carried out : taking the mother away, putting the litter in another cage, blending litters in a cage with a fixed number of rabbits, or other form.

1.3. Growing period

If the growing period is time-fixed, it is recommended to give the number of days from weaning to slaughter time.

1.4. Rabbit density

It could be interesting to determine the number of rabbits per cage or per square metre at the beginning of the fattening period.

1.5. Criteria of elimination

It is important to determine the criteria for excluding an animal from the experiment, not only the pathological criteria but also the criteria used to consider an animal as an outlayer at birth, weaning or during the fattening period.

1.6. Type of feeding

In many experiments it is important to establish whether the animals are fed ad libitum or restricted, and in the second case which sort of restriction. Also, it can be important to determine whether the food is commercial standard food or home prepared food -forages, etc...-. In both cases is interesting to know the diet formula, but, of course, essential in experiments concerning nutrition research.

1.7. Liveweight

1.7.1. Standardized liveweight

Liveweight of rabbits at the end of the control period of the experiment. If the control period finishes at fixed weight, the interval of weights used in the experiment has to be given. Standardized liveweight has to be taken before fasting or other treatments. Digestive tract content and urinary bladder, even in studies of body composition, must be included (BUTTERFIELD, 1988).

1.7.2. Other liveweights

If other weight is used as "liveweight" -vgr. slaughter weight after fasting or empty body weight-, it has to be clearly described.

1.8. Fasting : type and duration

Fasting can be from solids, liquids or both. The type of fasting and its duration should be specified.

1.9. Transport to the slaughter house

Meat quality can be affected by stress due to transport. In experiments about meat quality it is recommended to indicate the duration of the transport from the farm to the slaughter house. Occasionally the resting period before slaughter can be indicated.

1.10. Type of slaughter shock

In many countries there are legal norms about slaughter shock to prevent animals from suffering. It is convenient to describe the type of shock : electrical -with voltage and duration, if possible-, neck hit or others.

1.11. Reference body weight

It is difficult to determine the adult weight. TAYLOR (1985) offers a complete definition of mature body weight : "... weight of a normally grown, skeletally mature, normally active adult animal maintained in a state of body weight equilibrium on a standard diet, in a thermoneutral, disease-free environment with, or adjusted to, a chemical body fat of 20 %. It is difficult to measure this weight in most of the experiments. As a reasonable approximation, it is suggested to measure the liveweight several times -at least four times- at fixed time intervals -30 days minimum-. If the four measurements do not show any increasing trend in weight, the average can be considered as a Reference Body Weight, similar to the adult weight for many purposes. Nevertheless the following points must be determined :

1/ The genetic origin of the animals,
2/ The sex : there is sexual dimorphism in adult weight,
3/ The type of feeding -ad libitum or restricted, food type, ...,
4/ The season of the experiment,
5/ The physiological state of the does -after birth, pregnant, ...,
6/ Other causes that can affect the Reference Body Weight -special diets, hormonal treatments or others-.

2/ THE CARCASS

The abbreviations of ponderable traits end with the letter W, the length traits with L and the percentages with a P.

2.1. Commercial Skin Weight (CSW)

The skin is separated from the body by cutting at the base of the ears, muzzle and tail (at the level of the third caudal vertebra, at the level of the distal epiphyses of radius-ulna, and at the middle of the tarsal bones). This last cut permits the carcass to be hung by the hind legs. The Skin Weight includes the weight of the above-mentioned parts of the ears, muzzle and tail, but excludes the distal part of fore and hind legs. The Skin Weight also includes the weight of the hypodermic fat and other adhered fat depots, but excludes scapular fat depots.

2.2. Gastrointestinal tract weight (GW)

The gastrointestinal tract weight includes stomach and intestinal content, and the urogenital tract with empty urinary bladder.

2.3. Empty gastrointestinal tract weight (EGW)

Weight of the gastrointestinal tract, clean and dripped.

2.4. Hot Carcass Weight (HCW)

Weight of the carcass between 15 and 30 minutes after slaughter. The carcass does not include blood, skin, distal parts of tail, fore and hind legs, gastrointestinal tract and urogenital tract. The carcass includes Liver, Kidneys, Head, and the following set : Lungs + Oesophagus + Trachea + Thymus + Heart.

2.5. Commercial Carcass Weight (CCW)

Weight of the carcass described in 2.4, 24 hours after slaughter, the carcass having been refrigerated around one hour after slaughter, and conserved between 0 and 4 degrees centigrade, hung with normal ventilation or sufficient air around the carcass. The carcass should not have been cleaned -i.e. with water-.

2.6. Drip Loss Percentage (DLP)

This is the difference between Hot Carcass Weight and Commercial Carcass Weight, divided by Hot Carcass Weight, x 100.

2.7. Dressing Percentage (DP)

The dressing percentage is defined as the ratio between Hot Carcass Weight and Liveweight, x 100. Liveweight as in 1.7.

2.8. Length (LL) (see fig. 1)

Length of the commercial carcass is the sum of two measurements :

- from the atlas vertebra to the 7th lumbar verterbra (L1),
- from the 7th lumbar vertebra to the ischium insertion point (L2).

2.9. Circumference (CL) (see fig. 1)

Lumbar Circumference of the Commercial Carcass at the level of the 7th Lumbar vertebra, including abdominal wall.

2.10. Liver Weight (LW)

Weight of the liver, excluding gall bladder.

2.11. Kidney Weight (KW)

Weight of both kidneys without perirenal fat depots.

2.12. Thymus, Trachea, Oesophagus, Lung and Heart Weight (LHW)

Weight of this set.

2.13. Head Weight (HW)

Weight of the head, obtained by section at the level of Axis.

2.14. Reference Carcass Weight (RCW)

This is the carcass containing only fat, meat and bone tissues. It is the commercial carcass without liver, kidneys and the set of organs of neck and chest.

2.15. Perirenal Fat Weight (PFW)

Weight of the perirenal fat depots.

2.16. Scapular Fat Weight (SFW)

Weight of the scapular fat depots.

3/ REFERENCE CARCASS DIVISION

The carcass can be divided in joints to be weighed, according to several criteria.

3.1. Cutpoints

From a commercial point of view, the carcass has to be divided in joints that can be sold for cooking. However, in many scientific papers related to allometric and other carcass studies, a kind of "Anatomical" carcass division has been used until now. Because the two points of view are somewhat complementary, it is recommended to cut the carcass in the following order (see fig. 2) :

Cutpoint 1/ Between the 7th and 8th thoracic ribs, following the prolongation of the ribs when cutting the thoracic wall,
Cutpoint 2/ Between the last dorsal and the first lumbar vertebrae, following the prolongation of the 12th ribs when cutting the thoracic wall,
Cutpoint 3/ Between the 6th and 7th lumbar vertebrae cutting the carcass and the abdominal walls transversaly to the vertebral column,
Cutpoint 4/ Fore legs including the insertion and thoracic muscles.

3.2. Anatomical division

Cutpoints 2 and 3. Joints :

- Fore part (FPW)
- Intermediate part (IPW)
- Hind part (HPW)

3.3. Technological division

Cutpoints 1, 3 and 4. Joints :

- Fore legs (FLW) (including thoracic insertion muscles),
- Thoracic cage (TW) (first seven ribs, without the insertion muscles of the fore legs),
- Loin (LWW) (including abdominal wall, and the ribs after the 7th thoracic rib),
- Hind legs (HLW) (including the sacral bone and the lumbar vertebrae after the 6th lumbar vertebra).

The joints can be classified in :

- First retail cuts : hind legs, loin, and fore legs,
- Second retail cuts : limited to thoracic cage.

It is recommended to use the Technological division if possible.

4/ PREDICTION OF CARCASS COMPOSITION

4.1. Total muscle

Commercial carcass weight is a good predictor of the total muscle carcass weight, being the determination coefficient of the prediction equation near 0.9 (BLASCO et al., 1984).

4.2. Lean content

The most important criterium of carcass classification in pigs, beef cattle or sheep is lean content. This criterium is not so important in rabbits because the rabbit is very lean in comparison with other farm animals -it has less than 5 % of fat in the carcass-. As a consequence, the variability of rabbit lean content is much lower than the same variability in other species. Carcass weight, length measurements, length ratios, retail cut weights or hind leg meat are bad predictors of the percentage of meat of the carcass. Some combinations of these measurements in a regression equation are, nevertheless, fairly good predictors (BLASCO et al., 1984).

4.3. Meat/bone ratio of the carcass

The meat/bone ratio of the hind leg gives a fairly good prediction of the meat/bone ratio of the carcass (R^2 = 0.6, VAREWYCK and BOUQUET, 1982 ; BLASCO et al., 1984). Other carcass measurements give poor predictions of this ratio. Separation of hind leg is illustrated in fig. 3. The meat/bone ratio of the hind leg can be predicted by the same ratio of the cooked hind leg (R^2 = 0.7) when cooking conditions are standardized (under vacuum, 80 degrees centigrade, 2.30 hours) (OUHAYOUN, 1986).

4.4. Total dissectable fat

The percentage of perirenal fat is a reasonable predictor of the total dissectable fat (R^2 = 0.8) (VAREWYCK and BOUQUET, 1982).

5/ THE MEAT

5.1. Muscular pH (see fig. 4)

pH gives a good estimate of the glycolitic potential of the muscle if measured after a long chilling period (at least 22 hours at 2-4 degrees centigrade). In commercial carcasses the measure has to be taken in L. dorsi or in B. femoris muscle. It is recommended to use a penetration electrode (3 to 4 mm of diametre). It is convenient to measure the L. dorsi muscle always at the same place (5th lumbar vertebra), because the pH decreases from the neck to the caudal area (OUHAYOUN et DELMAS, 1988).

If the ultimate measurement is not reached, muscular pH can be measured accurately after crushing a sample of tissue in sodium idoacetate 0.05M (OUHAYOUN and DELMAS, 1988).

5.3. Colour measurements (non specific)

It is recommended to extract and measure the myoglobin content of the muscle according to the Hornsey's method (HORNSEY, 1956).

5.4. Water content, nitrogen and lipid content (non specific)

It is recommended to use the official methods of analysis of the country (ADAC in USA, NF norms in France, DGF or DIN in Germany, etc...). The methods used have to be detailled (vgr. : AFNOR norm NF V 04-401 for water content, NF V 04-403 for lipids content, etc...).

DESIGN AND ANALYSIS OF EXPERIMENTS

1/ SIZE OF THE EXPERIMENT

To determine the optimum size of the experiment is a difficult question because it depends on :

1/ the precision of the experiment, which has to be specified,
2/ The cost of the experiment and available facilities,
3/ The true value of the parameters.

Many times the optimum precision has to be disregarded because of excessive experimental costs. It is difficult to give general formulations because the final decision depends on the kind of experiment which is being carried out. For example, genetic correlations need -mainly when they are low- a massive amount of data to be estimated with some acceptable precision. If the traits are difficult or expensive to measure, an experiment with a lower accuracy need not be disregarded, as it may prove to be consistent with the results of other experiments.

There are many textbooks in which the techniques to obtain an optimum sample size are described. The recommendations in this paper must be understood as a general orientation about minimum requirements for many kinds of experiments.

2/ EXPERIMENTS IN EARLY STAGES

When no previous information is available, a usual procedure to find whether two treatments are different is :

1/ To choose a difference d between treatments, which is considered relevant enough to be detected,
2/ To select the desired probability P of obtaining a significant difference when the true difference is d (power of the test),
3/ To select the significance level α of the test to define the region of rejection of the null hypothesis.

The optimum size of each experimental group is, under some general conditions :

$$n = [Z_{\alpha} + Z_{2\,(1-P)}]^2 \; 2\frac{\sigma^2}{d^2}$$

where Z_{α} is the absciss of the Normal Typified distribution at a two-tails probability area α, and $Z_{2\,(1-P)}$ at the area 2 (1-P), and σ^2 the variance of the character (see vgr. SNEDECOR et COCHRAN, 1980).

Usual values for α are 5 % or 1 %, and usual values for P are 80 % or 90 %. In table 1, taken from SNEDECOR et COCHRAN (1980), the factor $[Z_{\alpha} + Z_{2\,(1-P)}]^2$ is offered for diverse α and P.

TABLE 1. Value of $[Z_{\alpha} + Z_{2\,(1-P)}]^2$ for diverse α and P

	α		
P	0.01	0.05	0.10
0.80	11.7	7.9	6.2
0.90	14.9	10.5	8.6
0.95	17.8	13.0	10.8

As an example, the procedure for calculating the size of the sample needed in order to find a difference in liveweight at 70 days of age, would be as follows :

1/ Specify the size of the difference to be detected (vgr. d = 0.1 kg),
2/ Specify the power of the test, vgr. P = 80 %,
3/ Specify the significance level, vgr. α = 5 %.

From table 1, $[Z_{\alpha} + Z_{2\,(1-p)}]^2$ is 7.9. From the bibliography, σ of liveweight at 70 days of age is accepted to be 0.2 kg, therefore $\sigma^2 = 0.04$. The number of rabbits per group that would be necessary to detect differences of at least 0.1 kg between treatments is :

$$n = 7.9 \times 2 \times \frac{0.04}{0.01} = 64 \text{ rabbits per group.}$$

If only two groups are compared, the total size of the experiment is $2n = 128$ rabbits.

3/ EXPERIMENTS WITH PREVIOUS INFORMATION

When previous information is available and there are indications about the size of the differences between treatments, the interest of the experiment may be to quantify these differences with a desired standard error instead of finding whether two groups are significantly different or not. As the standard error of a difference is, under certain assumptions,

$$SE = \sigma/\sqrt{\tfrac{1}{2}n} ,$$

-where σ is the standard deviation of the trait and n the size of each group-, at a fixed standard error SE, the size of each group would be :

$$n = 2\sigma^2/SE^2$$

As an example, to find a difference in liveweight at 70 days of age between two treatments with a standard error of 0.05 kg,it is necessary :

$$n = 2 \times 0.04 \,/\, 0.05^2 = 32 \text{ rabbits per group}$$

4/ CONDITIONS OF THE SAMPLES

We cannot detail here the general conditions of the samples -vgr. random samples, not biased, etc...-, but in experiments with animals, it is interesting to underline two points :

1/ If the animals of the sample are very related, the size of the experiment has to be increased, especially if the traits considered have a high heritability or high maternal effects.Therefore it is important in many cases to avoid using animals which come from, for example, only two sires or few litters.

2/ Sometimes the accuracy can be improved -and consequently the size of the experiment reduced- by using several parities of the same females and randomizing the treatments -vgr. half of the females with treatment A in the first parity and B in the second parity, and half of the females with treatment B in the first parity and A in the second. This reduces a part of the variance of the error due to the female.

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5/ WRITING SCIENTIFIC PAPERS

Norms for writing scientific papers can be found in the recommendations to the authors of the main scientific journals and in some textbooks -see, vgr., DAY (1989)-. Here only three important points will be stressed :

1/ Material and methods have to be described in sufficient detail so as to allow the reader to repeat the experiment,
2/ Statistical analyses have to be specified. The use of computer packages has facilitated the work of scientists, but the name of the program or package used must be considered insufficient information,
3/ If an exploratory data analysis has been done to find outlayers, or if any data have been disregarded, it must be indicated in the paper, along with the criteria used to eliminate the data form the experiment.

A more detailed orientation about how to make and publish statistical analyses can be found, for example, in the BSAP Statistical Guide for Authors and Editors (BSAP, undated).

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Figure 1. Linear measurements of commercial carcass

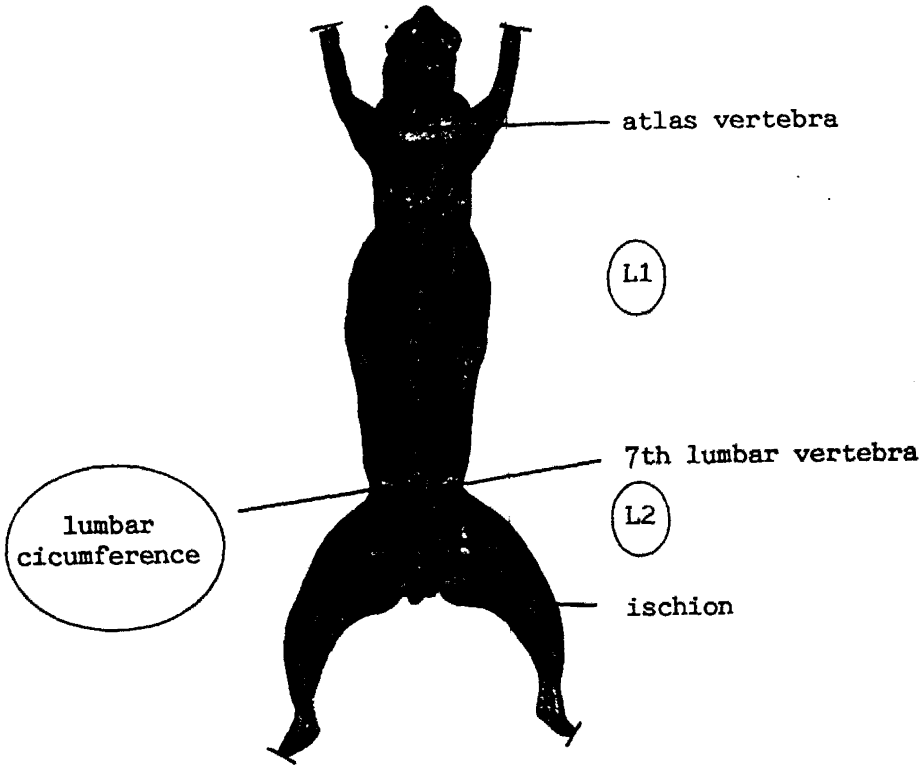

Figure 2. Cutpoints of reference carcass

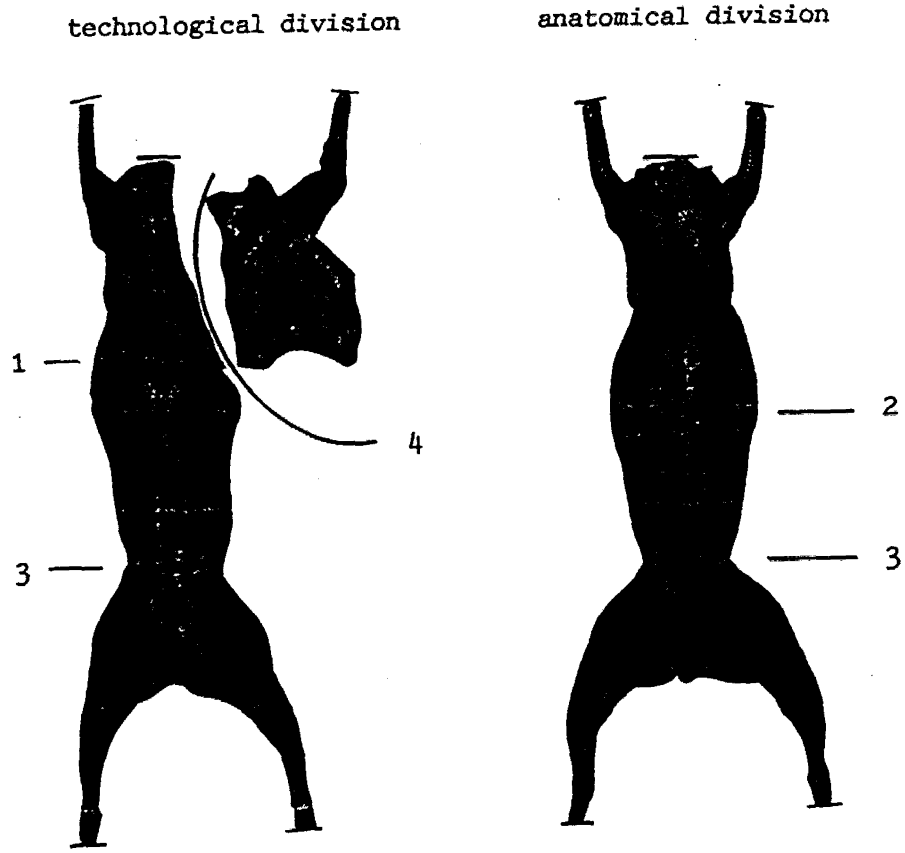

Figure 3. Muscle/bone ratio of the carcass.
Separation of hindleg.

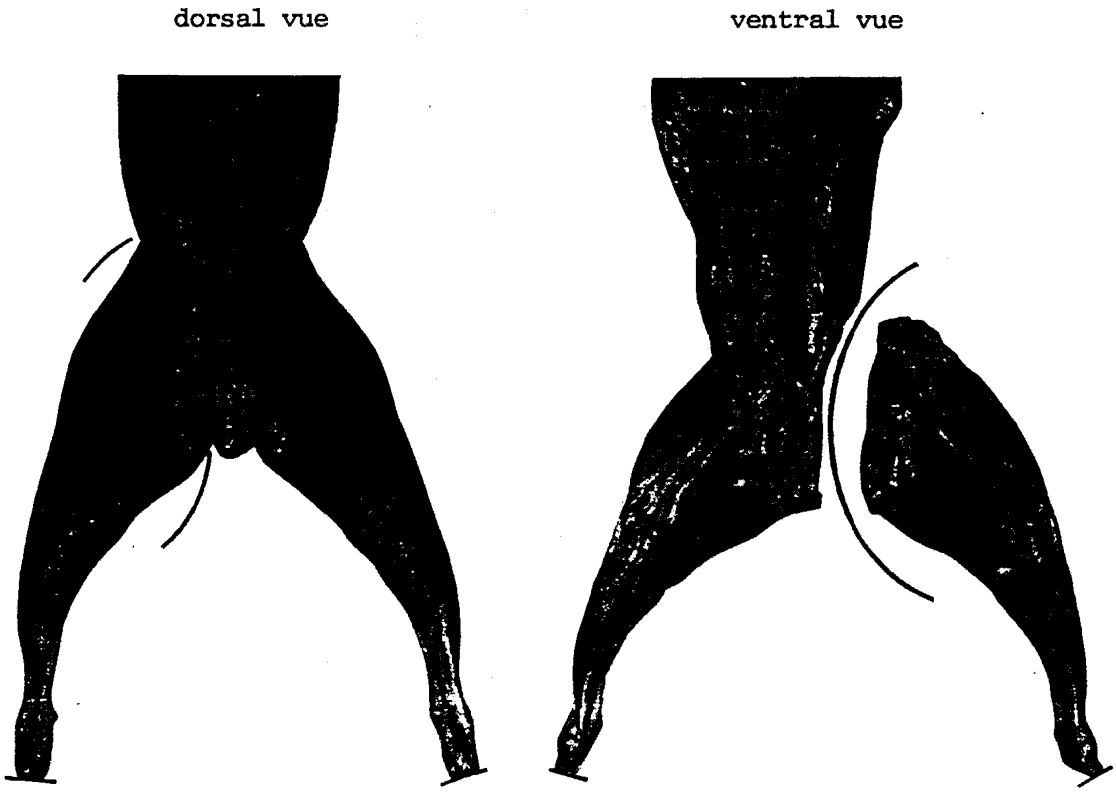

Figure 4. Muscular pH measurements.
Insertion of electrode.